A Proposed System for Identifying and Documenting Technology Transfer Opportunities within CANMET Laboratories

by

D.J. Doyle
Doyletech Corporation
Kanata, Ontario

Work on this project was conducted under the auspices of the Canada Centre for Mineral and Energy Technology, Energy, Mines and Resources Canada.

D.S.S. File No:	14SQ.2344-9-9181
D.S.S. Contract Serial No:	2344-9-9181/01-SQ
CANMET Project No:	
CANMET Scientific Authority:	
Date:	March 1990

34 pp

MICROMEDIA

91-00747/

Table of Contents

1. Introduction

2. The BOD Concept

3. The Format

    3.1 The Business Opportunity
    3.2 The Technology
    3.3 The Products/Services/Processes
    3.4 The Markets
    3.5 Investment and Payback

4. CANMET Business Opportunities

    4.1 Ferric Chloride
    4.2 Hyceram
    4.3 Jet Reactor
    4.4 Numerical Modelling Simulation
    4.5 Others

5. An Inventory System

    5.1 A menu of BOD's

6. Summary and Recommendations

7. Appendix

1. Introduction

There is a well recognized need for improved communications between the Canadian industrial/investment community and government laboratories. Nowhere is this need more pronounced than in the area of technology transfer. The two communities use different information and decision-making tools when it comes to identifying and evaluating technology. Scientists tend to rely on technical reports to tell both the scientific and industrial communities about their work, while industrialists and investors rely on business plans, marketing plans and financial documents to make decisions about investments in technology in the same way that they make other investment decisions.

This results in a communications gap that can be frustrating to both communities. The scientists find it difficult to understand why the publication of a scientific report or even a detailed description of the technology will not attract industrial partners to their research work. The industrialists/investors find it difficult to tell the difference between one scientific report and the next and even if they can, they are not interested in funding research that does not lead to commercially viable **products** and **services**, or to **processess** that can improve those products or services. They are more likely to be interested in technical reports that identify specific products, services and processes.

The government scientists also assume that the key decision makers in the private sector are technical people like themselves. Nothing could be further from the truth. The key decision makers are senior managers who are more preoccupied with return on assets and cash flow than with the details of the technology being presented to them. If the information cannot be presented to them in simple terms, along with some mention of market oppportunities, they are less likely to be interested in it. Very often their own scientists and engineers are no better at this than those in the government laboratories.

The problem is particularly serious in Canada because the industrial/investment community lacks confidence and experience in the exploitation of technology and because so much of what is available to them is in government laboratories that are not closely coupled to the marketplace. The problem is even more serious in the resource industries because they have resisted investing a great deal of money in research and

development and are therefore inexperienced in evaluating its benefits.

In these times of fiscal restraint there is an increased emphasis on maximizing the economic benefits from government-funded research. There is also an increased emphasis on the recovery of at least some of the costs associated with the delivery of services to Canadian industry. While improved communications will only go part of the way in achieving those objectives, it is an essential ingredient. It is also one that presents special challenges to the CANMET laboratories because of the diversity of their technological activities, the services they provide and the clients they serve.

This report recommends that CANMET implement a system of documenting its technology transfer opportunities in a manner that is understandable to **both** communities. It proposes a new communications vehicle to be known as a Business Opportunity Document (BOD) which would be prepared by the scientists with the help of CANMET's Technology Marketing Division. The BOD would contain information about the **technology**, but more importantly, information about the **products** and **services** that could be created and the **markets** they would address. The BOD would be made available to interested parties in the industrial/investment and research community and would form the basis of an inventory system for accumulating and tracking a number of technology transfer opportunities simultaneously.

2. The BOD Concept

The proposed BOD would be somewhat similar to what is known in the industrial/investment community as a new venture business plan, a product plan, or a business case. Its format would be flexible enough to accommodate an opportunity that is at a very early stage of development as well as one that is at a very advanced stage. **Its stage of development may or may not be directly related to the amount or type of research that has gone into the development of the technology.** For example, a pure research project that would appear to have little or no potential for creating a saleable product or service may have a requirement for a measurement instrument that is not currently available on the market and this could present an opportunity for a new product line in an existing company or even a new startup company.

If the technology is well defined and if the product and its potential markets are identifiable, there is no reason why the BOD should not bear a close resemblance to a new venture business plan or a document of the type that outside industrialists/investors use in their investment decision-making process. On the other hand, if only the technology is identifiable, the BOD would be nothing more than a "technology fact sheet" with a few ideas on potential products and markets.

It is therefore proposed that there be two classes of BOD's as follows:

BOD - 1 Where only the technology or the results of a research project can be described and some **suggestions** made about how it can be applied to the creation of products, services or processess.

BOD - 2 Where there are identifiable products, services or processes as well as markets.

3. The Format

The same format would be followed for both types of document. A BOD-2 would be more complete than a BOD-1 because it would contain marketing and financial information as well as technology and product information. It would typically include four or more pages whereas a BOD-1 might include only one or two.

A BOD would have the following headings:

- The business opportunity
- The technology
- The products/services/processes
- The markets
- The investment and payback
- Technology Transfer Possibilities

Obviously, if the opportunity is only at the BOD-1 stage not all of the headings may apply, but both types of document should start with a statement of the business opportunity because that is their main purpose.

The following table illustrates the differences between the two types of document:

	BOD-1	BOD-2
The Business Opportunity	A statement of why the technology should be of interest to an outside investor.	An expanded statement which describes products, services and processes that the technology will create and the markets they will address.
The Technology	At least a broad categorization with a list of key ingredients.	A statement of technological progress to date, descriptions of competing technologies, etc.
The Product/ Service	A description of any obvious products, how they would be developed and the benefits they would bring to the user.	A description of a family of products, a product migration strategy, an assessment of product lifetime, etc.

The Markets	Enough basic data provided to illustrate the commercial viability of the product.	An analysis of target markets in sufficient detail to assess incremental sales or profits over an extended period (usually five years).
Investment and Payback	Optional	An assessment of the capital outlay required to exploit the opportunity and an analysis of the return on that capital based on either incremental sales or profits
Technology Transfer Possibilities	How the exploiter might work together with CANMET	How the exploiter might work together with CANMET

The following sections describe how the proposed format would be applied. They refer to a fictitious business opportunity which would fit into the BOD-2 category. It should not be implied from this illustration that any such opportunity exists within CANMET or any affiliated organization.

3.1 The Business Opportunity

This is a simple statement of why an outside industrialist/investor should invest in the further development of the technology. In order to catch his or her attention, the first sentence should address the **technology**, the **products** and **markets** involved. An example would be:

> "The work in three-dimensional seismic sensor development which has been carried out at the CANMET laboratories has resulted in the identification of a software-controlled device that could be used to locate the source of a seismic disturbance in a novel way and that could form the basis of a new type of rockburst monitoring system in a mine".

The opportunity statement should not require more than two or three sentences and it should be in non-technical language.

3.2 The Technology

This is a brief description of the technology to indicate whether or not it is compatible with the potential exploiter's internal capabilities and/or investment preferences. Using the above business opportunity, an example would be:

> "A software program has been developed to differentiate between the P waves and the S waves arriving at each of three triaxial sensors so that the source of the disturbance can be located through a process of triangulation. This is made possible by the development of sensors, signal capturing and data processing techniques that can be applied in the field and that allow the differentiation of P and S waves in real time. Up to now, this has only been possible in a laboratory environment with the aid of very large and expensive computers. Since microprocessors are now available that have the power of such large and expensive computers of a few years ago, it is possible to incorporate one into a field instrument that would be attached to the wall of a mine and that would act as a search device in much the same way as direction finders act in the location of radio signals".

Some amount of technical jargon is allowable in the description of the technology, but if possible, analogies should be drawn between this technology and that which is available and is being applied in other fields, as was done above. The technology statement need only contain two or three sentences.

3.3 The Products/Services/Processes

This should contain a very concise and clear description of what the scientists and/or marketing officer envisage as **the medium that will produce profits for the exploiter.** An example for the above ficticious opportunity would be:

> "The product would be a ruggedized field instrument that would be attached to the wall of a mine and that would be capable of communicating with mine management sites both above and below ground. The supplier of such a product would also provide the communications systems that would interact with it. The actual installation would be done by mine personnel but the supplier would be required to provide installation and operational training as well as software and hardware

support. Consulting services may also be required, but these could be provided by a third party".

The thing to note about the above statements is that they give the potential exploiter a fairly clear idea of what business he or she would have to be in to exploit the opportunity. In this case, it would be the design, manufacture and distribution of both hardware and software as well as the supply of consulting and support services.

If possible, the product discussion should address the issue of a product migration strategy because most investors will want to see what the follow-on products are likely to be. Scientists can be very helpful in this regard because they are knowledgeable about the trends in the technologies on which the products and services are based.

3.4 The Markets

Each major target market should be listed along with its potential for sales revenue over some period of time after the formation of a new product line or new company to exploit the opportunity - usually a five year period.

The following would be an example in this instance:

"The target markets for this system are the hard rock mines throughout the world. The following is a breakdown of their total by geography:

Canada _____
U.S._____
Europe _____
Africa_____
Rest of world_____

Many of these mines are already using rockburst monitoring systems, but they require many more sensors than would be required with this concept. They therefore require extensive wiring that is subject to damage by mining equipment. Their data is more difficult to interpret and this makes them inherently less accurate than the proposed system. Penetration of this market should be relatively easy

because many mining companies would install this new system and allow it to operate in parallel with their existing systems before making the complete changeover".

Some mention should be made of **competitive** factors relating to the technology as well as the products. For example:

"Experiments on the use of "tunable" seismic sensors have been carried out in some mines in South Africa. They have demonstrated the technical feasibility of the concepts. A breadboard system is in use at one mine but no attempt has been made to productize it. The CANMET system would be easier to productize because the communications technology is further developed and it permits the instrument to be made much smaller and the overall system to have less wiring".

If possible, the market analysis should be carried to the point where sales figures can be estimated for each of the first five years of operation for the new product line or company.

3.5 Investment and Payback

In this section, the marketing data is turned into five year sales projections for a **family** of products that would be marketed by the new company or product line and these are used to determine cash flow and thus the investment required and the payback expected. For example, let us assume that sales will build up from zero in the first year to $20 million in year 5, that losses will total $1.5 million during the first two years, the company will be profitable thereafter, that $1.0M of capital equipment is needed during the first two years and that $1.0M is needed for working capital (inventory, accounts receivable, etc.) during this same period. This likely means that $1.5M + $1.0M + $1.0M or $3.5M of **risk** capital is needed because the company (or product line) will have no accumulated assets that can be used as collateral.

The return on this **risk** investment is what the investors are interested in, whether they be outside investors or the management of an existing company. Therefore, they will want to know what the new venture will be worth at the end of the five years. This is

dependent on a number of factors such as its retained earnings, the volatility of its markets and the need for ongoing investments in new technology, but a good rule of thumb is that a company will have a fair market value at least equal to its annual sales if it has a reasonable profit history.

If this company (or product line) can get by with only $3.5 million of risk capital and it can be sold for $20M, this means the payback factor is 5.7 which translates into slightly more than 40% rate of return compounded annually. Different investors and industrial partners will be interested in different ways of measuring payback; some will be concerned about return on investment (ROI) while others will be concerned about return on assets (ROA) and still others about net profits as a percentage of sales. Enough financial data should be provided to let them assess all of them, at least in a general way.

Obviously, there is a limit to how far either the scientists or the CANMET marketing officers can go in estimating investment and payback, but they should at least indicate to the potential investor how capital intensive the project will be and how long it will take to produce some sort of payback. The scientists definitely have a role to play in this because such things are heavily dependent on the complexity of the technology and its rate of change.

4. CANMET Business Opportunities

This section will illustrate how the BOD concept can be applied to specific CANMET business opportunities including four which were discussed in an earlier Doyletech report entitled "Study of Technology Transfer Opportunities in CANMET Laboratories" dated December 28, 1989. They are:

- Ferric Chloride - a leaching system for treating base metal ores.
- Hyceram - a material that acts as a conductor for hydrogen ions.
- Jet reactor - a process for reducing the viscosity of heavy oils.
- Numerical Modelling - a software package for analyzing stresses in mines.

The first one falls into the BOD-1 category and the next three into the BOD-2 category.

4.1 Ferric Chloride

The opportunity document in this case would be a BOD-1 because even though the technology has been demonstrated using a laboratory scale model, it is not clear what form a commercially viable product would take. It is also not clear if it could be retrofitted into existing mines or if it could only be justified in new mines. In fact, it may never be used in mines at all but in the reworking of mine tailings.

What is known is that it offers a **technically** superior solution to the extraction of base metals from ore concentrates than those used at present. If it can be put into practice at costs which are in line with existing methods, it represents a viable business opportunity.

BUSINESS OPPORTUNITY DOCUMENT
Ferric Chloride Leach Process
Classification: BOD-1

The Business Opportunity

A leach process has been developed at CANMET which has the potential of changing the way in which base metals (lead, zinc, copper, silver, etc.). are recovered from ore concentrates. It offers many advantages over the usual methods of recovery, such as improved yield and the elimination of sulphur dioxide as a byproduct.

The process has been demonstrated in the laboratory. The next step in its development is to operate the process at the pilot plant scale. This would provide the necessary process and engineering data to build a working prototype and install it at a mine site, either an existing mine, or a mine tailings site.

The Technology

The process consists of

- A two-stage ferric chloride leach
- lead chloride crystallization from leach liquor
- lead electrowinning and chlorine recovery
- copper-silver cementation on iron
- zinc chloride separation and purification by solvent extraction
- lixiviant purification and iron removal by oxyhydrolysis
- lixiviant regeneration with chlorine
- cadmium recovery

The Products/Services

The exploitation of this technology will result in the development of a new mining or metal recovery process as opposed to a new product or service. A mining company is the most likely exploiter, at least in the short term. However, as the process becomes more widely accepted, it is possible that such a system could be offered to the metal concentrate producing and processing companies on a turnkey basis.

It offers the end user the following advantages:

- Elminates the need to produce selective concentrates from complex ores; a bulk concentrate, produced by low cost bulk floatation is treated by the ferric chloride process.
- Bulk floatation provides very high recovery values from concentrate.
- The by-products of the process generate revenues (e.g. sulphur).
- No sulphur dioxide is produced.
- The producer is relieved from sulphuric acid production and the problems involved in its marketing.

The Markets

The following are the target markets for a system based on this process:
- Base metal mines.
- Owners of mine tailings sites (e.g. municipalities, mining companies).

The base metal mines represent the greatest market potential. Most of them are currently operating at full production capacity and significant new capacity will be needed within the next decade. Also, the supply of clean concentrates is diminishing throughout the world and future supplies are likely to come from fine-grained complex ore bodies for which this process was designed.

The following is a breakdown of the Canadian base metal mining industry (as of 1988).

Type of Metal	No. of Mines	Value of Production ($M)
Copper	39	2,317
Zinc	23	2,065
Lead	9	333
Silver	5	378

(Sources: Mining Association of Canada and Canadian Minerals Handbook, Energy Mines and Resources.)

Investment and Payback

The cost of a turnkey installation in an average zinc mine (100,000 metric tons per year) would be in the $300M range. The cost of production would be approximately 24 cents per pound of zinc. Technical and feasibility studies have been carried out and they show that the discounted cash flow rate of return could be almost 10% greater than with conventional processing (27% vs. 19%).

The cost of constructing a pilot plant to prove the operational feasibility and payback potential would be approximately $5M. With the help of CANMET scientists and engineers, it could be brought on stream in about 36 months.

Assuming that the total value of base metal production in Canada alone is now in the $5 billion per annum range, this would represent 1% of one year's production for the entire industry.

Technology Transfer Possibilities

CANMET is seeking industrial partners to bring the project to the pilot plant stage. The licensee would have the right to use the technology and market the products and services that flow from it.

Contact:

Dr. D.H. Bell, Mineral Science Laboratories, CANMET
555 Booth St., Ottawa, Ontario, K1A 0G1
Tel: (613) 992-0920
Fax: (613) 996-9673
Telex: 0533117 EMR OT

4.2 Hyceram

This is given a BOD-2 classification because the technology is already being exploited by a small firm in the Toronto area to supply hydrogen detection and measurement systems for the steel industry. The opportunity document would be as shown on the next two pages:

BUSINESS OPPORTUNITY DOCUMENT
Hyceram
Classification: BOD - 2

The Business Opportunity

Research in the area of solid electrolytes which has been conducted by the Ceramics Section of the Mineral Processing Laboratory, CANMET, has resulted in the development of a ceramic that is a conductor of hydrogen ions. Devices which could utilize this as an electrolyte include hydrogen sensors, hydrogen pumps, steam electrolyzers and fuel cells.

The Technology

Hyceram™ is a hydrogen-conducting ceramic for which Canadian and U.S. patents have been issued. The technology is based on the concepts of ion-exchanging a fast-ionically-conducting precursor such as a beta-alumina or Nasicon in powder form and then bonding the exchanged powder. The process is simple and inexpensive.

In addition to this material technology, a number of electrochemical cells have been developed. Operating under the open-circuit condition, the sensor does not require an ionic current. The pump, electrolyzer and fuel cell require high currents for practical devices, a limitation of all present hydrogen conductors.

The Product

A market study carried out by CANMET's technology transfer group in 1986 indicated that the two most likely products to flow from this technology would be the sensor and the electrolyzer. Since that time, a Toronto area firm has used the sensor technology to develop a hydrogen-sensing device for use in a steel process. In another project, a hydrogen pump has been demonstrated for tritium removal in a nuclear plant.

The Market

The applications for each of the four types of devices are as follows:

Hydrogen Sensor	- hydrogen detection and measurement, hydrogen handling, steelmaking, petroleum and chemical processes.
Hydrogen Pump	- hydrogen and tritium removal, electrolysis, methane reforming.
Water/Steam Electrolyzer	- hydrogen production.
Fuel Cell	- electrical power for industrial, commercial and residential uses.

The Hyceram technology will be of interest in other applications where environmental cleanliness and energy efficiency are important.

Investment and Payback

Insufficient data is presently available on any of the above markets to indicate their total potential and the direction which the product migrations should take.

CANMET scientists are willing to assist potential development partners in such product and market identification and in estimating the funding of R&D programs.

Technology Transfer Possibilities

CANMET is seeking licensees for the Hyceram™ and cell technologies on a non-exclusive basis. Test cells are available at CANMET to evaluate their applications in hydrogen systems. CANMET is also willing to enter into contract research arrangements with outside firms or organizations on the further development of these technologies.

Contact:

Dr. J.D. Canaday or Dr. T.A. Wheat
Ceramics Section
Mineral Sciences Laboratory
Dept. of Energy, Mines and Resources
555 Booth St.
Ottawa, Ontario
K1A 0G1

Tel: (613) 992-6462

4.3 Jet Reactor

This is a molecular shearing process developed jointly by CANMET and the University of Sherbrooke for reducing the viscosity of heavy oils and certain other similar compounds. It operates by forcing the compound through an orifice under very high pressure (1200 p.s.i.). Hydrogen is used as the gas to produce the high pressures. The molecules of the compound are physically rearranged in the shearing process and this prevents them from recombining after the thinning process which is one of its advantages over competing processes. Another is that it does not require the use of diluents or additives.

This opportunity is classified as a BOD-2 because the technology is demonstratable and there is also a fairly clear definition of the product characteristics. What is less known is who the actual exploiter(s) would be. Although discussions have been held with a number of major oil companies, the eventual exploiter might be a manufacturing firm that supplies products, services and systems to the oil companies and the pipeline companies.

BUSINESS OPPORTUNITY DOCUMENT
Jet Reactor
Classification: BOD-2

The Business Opportunity

To develop a new type of system for reducing the viscosity of heavy oil.

The Technology

This process uses a high shear jet reactor consisting of a medium pressure stainless steel vessel equipped with a specially designed pressure nozzle. It is based on the concept of breaking up the micellar structure of asphaltenes which are responsible for the high viscosity of heavy oils such as Alberta bitumen.

The Product/Services

The product would be a system costing in the range of $1M to $5M and which would likely be used at the input to a major pipeline. It is estimated that throughput capacity would be approximately 1,500 cubic meters per day.

The Market

The end users of this type of plant would be the major petroleum producing companies and major pipelines. It is unlikely that the latter would ever build such a system on their own but would prefer to buy it from a company that already supplies them with hardware and services. While some oil companies might be interested in developing such a system using their own engineering departments, many would have the same preferences as the pipelines, namely to buy from a third party.

The total daily production of heavy oil and crude bitumen in Canada is currently about 55 thousand cubic meters per day. While this figure is still well below that for the combined total of light and medium oil (approximately 160 thousand cubic meters per day), its growth rate is considerably higher, as illustrated in the following table.

Canadian Petroleum Production by Type

(in thousands of cubic meters per day)

Year	Light	Medium	Heavy	Crude Bitumen
1978	167.4	13.0	18.2	1.2
1979	189.9	12.1	19.6	1.6
1980	175.2	11.5	19.1	1.5
1981	156.1	7.8	20.3	2.1
1982	151.5	8.6	19.1	3.4
1983	154.9	9.1	22.0	4.0
1984	165.3	10.3	26.3	5.3
1985	159.7	10.5	28.6	8.1
1986	149.7	10.5	29.4	14.8
1987	153.9	12.0	31.1	18.4
1988	158.7	11.9	32.4	20.8
1989(est)	149.7	11.7	33.0	20.6

(Source: Energy Statistics Handbook, EMR)

Investment and Payback

An investment in the range of $5M - $15M would be required to develop a working prototype. It is estimated that ten such systems could be installed in Western Canada during the first three years. The average selling price per system would be $3M. Insufficient information is available on throughput to determine cash flow for either a manufacturer or a user of the equipment.

Technology Transfer Possibilities

CANMET wishes to establish a working relationship with one or more oil producing companies, pipeline companies or firms that supply products and services to the petroleum industry.

Contact: Mr. W. Dawson
Energy Resource Laboratory
CANMET
Bells Corners, Ontario
Tel. (613) 996-5298

4.4 Numerical Modelling Simulation

Several software packages have been developed at CANMET for use on a personal computer which allow mining engineers, consultants, researchers and teachers to analyze the stresses and strains in a rock mass surrounding a mining excavation. Up to this time, such analysis capability has only been available on larger minicomputers and mainframes.

Since the technology, the product, and the markets are all identifiable, this opportunity is classified as a BOD-2 and would be documented as shown in the next three pages. It is more complete than the last two BOD-2 documents because enough data was available about the product and its target markets to allow revenue projections to be made.

BUSINESS OPPORTUNITY DOCUMENT
Numerical Modelling Simulation
Classification BOD-2

The Business Opportunity

A PC-based software system has been developed at the CANMET laboratories in Ottawa for analyzing stresses and strains encountered in mine excavations. It is primarily a design tool and would be used by mining engineers, consultants, teachers and researches. Training and consulting services would also be sold along with the software.

The Product/Services

The product operates under the DOS operating system and provides a display of stresses, strains and other parameters in two dimensions on a CRT screen. It is menu driven and is capable of being operated by personnel with little or no computer or keyboard skills.

The next version of the product, which will be available in about twelve months, will operate under UNIX or a similar operating system and will have three-dimensional graphics capability.

The present package sells for $300 and the new package will sell for between $2,000 and $3,000.

Workshops for training users will be another source of revenue. A typical one-day workshop will generate between $2,000 and $10,000 (between 4 and 20 seats @ $500/seat).

The Market

Target Markets

- rock mechanic engineers in mines
- consultants
- teachers and researchers

Market Potential - i.e. total number of units that could be sold to each of the above target markets.

Target Market	Potential		
	Canada	U.S.	Foreign
Rock mechanic engineers	150	1000	1000
Consultants	10	100	100
Teachers and Researchers	10	100	100

Market Penetration

- most of the above have access to the existing programs operating on minicomputers and mainframes, but none of them have PC-based programs.

- the market objective is to have the CANMET 2-D product in 80% of the Canadian potential market, 50% of the U.S. potential market and 10% of the foreign markets by the fifth year. It is also assumed that one third of this penetration will be possible with the 3-D product (i.e. 33% of the 2-D users will also buy the 3-D product).

- some of the factors behind these assumptions are the close working relationships between all of the target markets in Canada, the high cost of penetrating the U.S. market, and the difficulty in providing training and support services to the foreign markets.

- competition will also be a greater factor in the foreign markets because foreign governments will likely favour locally-developed packages.

Investment and Payback

Using the above assumptions about market penetration, the following number of packages and training courses could be delivered to each of these target markets during the five year period.

Market	Product 2-D	3-D	Training	
Canada				
Rock mechanic engineers	120	36	5	
Consultants	8	3	2	
Teachers & Researchers	8	3	2	
U.S.				
Rock mechanic engineers	500	150	10	
Consultants	50	15	5	
Teachers & Researchers	50	15	5	
Foreign				
Rock mechanic engineers	100	30	5	
Consultants	10	3	1	
Teachers & Researchers	10	3	1	
Totals (Units)	856	258	36	
Unit Selling Price	$300	$2,000	$5,000	
Sales Revenue	$256,800	$516,000	$180,000	
Total				$952,800

To acheive these sales revenues the following investments would be required:

1. Operating losses during first two years	$100,000
2. Investment in assets	$50,000
3. Working Capital (Working Inventory, Accounts receivable etc. during first two years)	$50,000
Total	$200,000

The payback from this product by itself is obviously marginal. However, it would provide an existing consulting firm or computer supplier an opportunity to acheive a presence in the mining industry.

Technology Transfer Possibilities

CANMET wishes to establish a working relationship with a computer hardware or software supplier or a consulting firm that would use this product as a launching pad for a range of products or services for the mining industry.

Contact:

Mr. Yang Yu
Energy Resource Laboratory
CANMET
Bells Corners, Ontario
Tel. (613) 996-1809

4.5 Others

Using the above four BOD's as examples, staff from CANMET's Technology Marketing Division compiled four others which are shown in the Appendix. They are:

- Diesel Exhaust Cleaning System - a ceramic filter which is capable of dramatically reducing soot emissions from diesel engines.

- Mine Ventilation Systems - technology for ventilating mines more efficiently.

- Supplementary Cementing Materials - a process which has the potential of significantly reducing both the energy and the cost of raw materials used in cement making.

- Identification of Sulphide Stress Cracking in Pipelines.

5. An Inventory System

By keeping the BOD's to less than five pages in length, it should be possible for CANMET to collect and maintain all current business opportunities in a reasonable-sized binder which could be used as a catalogue in discussions with outside investors/exploiters. If the catalogue becomes too bulky, it could be reduced by converting the BOD-2's to BOD-1's, but since the number of BOD-2's is always likely to be less than the number of BOD-1's, it is recommended that they both be included in their original format because otherwise it could be confusing to all the parties involved - the CANMET scientists and market development officers who prepare them, and the investors/exploiters who read them.

Such a catalogue should be updated at regular intervals and there should be special recognition for the scientists and technical personnel whose work leads to the development of a BOD of either type.

5.1 A Menu of BOD's

In addition to the catalogue, it is recommended that CANMET summarize all of its BOD's in a menu format using the same headings as are used in the BOD's. The following table illustrates how the BOD's discussed in the last section would appear in such a menu.

Business Opportunity	Classification	Technology	Products/Services	Markets	Investment & Payback	Technology Transfer Possibilities
Ferric Chloride - a hydro-metallurgical process that could result in a new method of extracting base metals from ore concentrates.	BOD-1	A leach process for treating bulk concentrates.	A new ore recovery process/system.	• Base metal mines. • Ore processors. • Mine tailings site owners.	• $5M required for a pilot plant. • $300M for first turnkey system. • Canadian base metal production is in excess of $5B per annum.	• CANMET seeking industrial partners for further development.
Hyceram - an advanced material which coud be used to produce hydrogen sensors, pumps, generators and fuel cells.	BOD-2	Bonding of ion-exchanged powder.	• hydrogen sensor already developed. • hydrogen pump demonstrated.	• research laboratories. • steel mills. • nuclear power plants.	• Unknown • Further product and market identification required.	• CANMET seeking licensees and research contracts for further development.
Jet Reactor - a process that could result in a new method of reducing the viscosity of heavy crude oil.	BOD-2	A jet reactor which uses high pressure hydrogen to shear the micellar structure of heavy crude.	• a treatment plant that would be used at the input to a pipeline or refinery. • a research tool.	• pipeline companies. • petroleum companies. • research laboratories.	• $5-15M required for a prototype. • ten systems could be sold within five years at $3M each.	• CANMET wishes to establish a working relationship with an end user or a manufacturer of such a system.
Numerical modelling - a software package that could be used by a software supplier or consultant to gain entry into the mining market.	BOD-2	Software	• a PC-based software package that allows mining engineers to analyze stresses near mine openings • currently operates in two dimensions. • a three-dimensional system under development.	• mining engineers. • consultants. • universities. • research laboratories.	• approximately $200,000 investment required. • annual sales at maturity approximately $400,000.	• licenses to consulting or computer firms.

6. Summary and Recommendations

The above BOD's were constructed over a three month period with the help of Mr. Leroy Murray of CANMET's Technology Marketing Division.

The following is a list of observations and recommendations based on that work:

- The BOD concept is more appropriate than the business plan concept proposed in the Dec./89 Doyletech report. It is less intimidating to the scientists and allows for more flexibility in content and format. Initially, a three-stage BOD was considered, but the two-stage format seems to be adequate for capturing all business opportunities regardless of their stage of development.

- A great deal of marketing information appears to be readily available inside CANMET but the scientists seldom refer to it in assessing the value of their technology. CANMET's Technology Marketing Division should make them more aware of this pool of marketing information and how to use it. The scientists were not intimidated by the basic principles of marketing (potential, penetration, share, segmentation, etc.) when these principles were explained to them. They are aware of the need to assess the value of their technology but they tend to use scientific criteria (number of papers published, international recognition, etc.) as the basis for assessment.

- Face-to-face dialogue with the scientists is essential in constructing the BOD's. During discussions with some of them, it was possible to identify other product and service opportunities from the same (or allied) technologies. They were also more knowledgable about the markets for such products and services than they thought they were. However, they seemed to have a greater confidence in the ability of their technology to deliver services as opposed to products.

- Their main preoccupation seemed to be with attracting R&D funds to their projects, and they perceived that the best way to do this was to enter into long-term working relationships with the end users of products or services that might flow from their technology. However, it was obvious that they might sometimes be better advised to seek out third parties that would provide such

goods or services to the end users. The Jet Reactor case was an example; the best exploiters of this technology would likely be manufacturing or consulting firms that supply similar products and services to the pipelines and petroleum companies, but the scientists were only communicating with the petroleum companies.

- CANMET has done a good job of sensitizing its scientists and engineers to the need for industrial relevance in their work; what is lacking is a reward system that would encourage them to add the marketing dimension that is called for in the BOD concept.

Appendix

Examples of

Business Opportunity Documents

BUSINESS OPPORTUNITY DOCUMENT
Supplementary Cementing Materials
Classification: BOD-2

The Business Opportunity

A process has been developed which has the potential for making a significant savings in both energy and resource inputs to the Canadian cement industry. Approximately 11 million tons of portland cement are used annually at a value of $1 billion. After aluminium and steel it is the highest energy-using industry in Canada.

The Technology

CANMET undertook to explore the use of various byproducts from Canadian mineral industries as supplements to regular aggregates in the production of concrete. A number of breakthroughs have been made, including:

1. High strength light weight concrete which can be used in structures to reduce weight and thus reduce the size of supporting columns.
2. The use of blast furnace slag to displace up to 90% of the cement.
3. Substituting fly ash for cement.
4. The development of high volume fly ash concrete using up to 60% fly ash.
5. The conducting of research on silica fume concrete.

Engineering data is available on the amount and percentage of supplemental cementing materials required to control the alkali-aggregate reactions which are costly in the maintenance of concrete structures. Data is also available on the use of high strength, low permeability, and high impact-resistant concrete and grouts for such applications as offshore structures.

The Products/Services

The development of this technology has resulted in a number of valuable applications.

1. The use of metallurgincal and industrial wastes for partial or total replacement of portland cement in cemented mine backfill. In the Sudbury basin of Ontario blast furnace slag is being used for the total replacement of portland cement in mine backfill.

2. The use of fly ash in making concrete. It is already used extensively in Nova Scotia where about 16,000 metric tons (market value approximately $1M) are used annually.

The Markets

Strong links have already been established by CANMET scientists and engineers with a number of industries:

- the cement, aggregate and concrete industry
- the steel industry
- the petroleum industry, especially those companies involved in offshore drilling
- the slag industries
- Transport Canada
- the mining industry

The most promising of the less energy-intensive materials for replacing cement are granulated slag, fly ash and silica fume. The energy required to produce granulated slag is estimated at only 25% of that for portland cement.

Fly ash and silica fume are industrial byproducts and are therefore very inexpensive.

Investment and Payback

To date, the CANMET research program has resulted in a number of valuable applications:

- **Mine Backfill**

  Slag, as a watse product from blast furnaces, can displace up to 90% of cement which is used as the principal binder material for mine backfill. The slag is sold at $80-85 per ton which is 15% below on the cost of the cement.

  The process also saves on disposal costs since slag is a waste product. It adds value to the slag, solves an environmental problem, and saves on transportation costs.

  In addition, the use of about 50% slag as a partial replacement for cement solves the alkali-aggregate problem.

- **Fly Ash in Concrete**

  Fly ash is a low dollar value substance. It can be obtained for about $1 per ton and it can displace up to 60% of the cement in concrete that has a value of $100 per ton.

- **High Volume Fly Ash**

  This allows the use of up to 60% fly ash at a great savings in cost and with improved properties, such as low permeability, durability, and no alkaline aggregate problem. Two construction projects in Halifax that have already used this approach in structural concrete.

  This product will find applications in massive structures such as hydroelectric projects or thick foundations for high-rise buildings.

- **Silica Fume in Concrete**

  The concrete incorporating silica fume has very low permeability which makes it ideal to repair bridges with salt damage.

Technology Transfer Possibilities

CANMET is seeking to promote the acceptance and use of new cement technologies.

Contact:

V.M. MALHOTRA
Mineral Science Laboratories
CANMET
555 Booth St.
Ottawa, Ontario
K1A 0G1

BUSINESS OPPORTUNITY DOCUMENT
Diesel Exhaust Cleaning Technology
Classification: BOD-2

The Business Opportunity

A ceramic filter has been produced by CANMET which is capable of reducing the soot emissions from diesel engines that produce hot gases. It offers many advantages in mining operations such as the reduction of maintenance costs of underground diesel engines and downtime losses. The reduction of soot also leads to a lower carcinogenic risk.

A Canadian firm is already producing the filter under license from CANMET and other industrial partners are being sought to explore and develop other applications.

The Technology

The purifier consists of an exhaust-mounted filter that removes over 90% of the smoke particles before they leave the exhaust pipe. The purifier is based on a ceramic honeycomb full-flow filter in which the exhaust gases are forced through the walls of the honeycomb structure, thereby trapping the smoke particles. The filtered exhaust is virtually invisible and reduced in odour.

Additionally, a catalyst can be incorporated into the system for carbon monoxide and gaseous hydrocarbon control.

The Products/Services

The products that will flow from this technoogy will depend on who the exploiters are and the problems they address. Although mining companies are the most likely immediate exploiters, the technology could have applications in the surface transportation industry as regulators call for cleaner emmissions from diesel vehicles. In underground applications, it offers the following advantages:

- Reduced carcinogenic risk.
- Improved visibility which results in improved productivity and reduced risk of accident.
- Reduced cost of ventilation systems in mines.
- Increased time between rebuilds of underground diesel engines by a factor of two. This will reduce cost of rebuilds, downtime and the need for replacement back-ups.

The Markets

Although the ceramic filter was originally developed for use in mines, its major market potential is likely to be in the surface transportation industry. In 1991 the Canadian and United States governments will be introducing legislation standards for soot levels. Filters will play a key tole in meeting these regulations.

Investment and Payback

The main payback to either the mining or the surface transportation industry will result from reduced costs in meeting these tough environmental standards.

Technology Transfer Possibilities.

The technology developed by CANMET has been transferred to a Canadian firm who are currently marketing the filter in the United States and the United Kingdom. CANMET scientists and engineers can assist in the identification and development of other business opportunities which make use of the existing filters or new ones yet to be developed.

Contact:

Mining Research Laboratories
CANMET
555 Booth St.
Ottawa, Ontario
K1A 0G1